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Are biofeedback techniques effective in reducing stress in the workplace?

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A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

In Partial Fulfillment of the Requirements For

The Degree of Master of Science

In

Health Sciences – Physician Assistant

Department of Physician Assistant Studies
Philadelphia College of Osteopathic Medicine
Philadelphia, Pennsylvania

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ABSTRACT

Objective: The objective of this selective EBM review is to determine whether or not biofeedback techniques are effective in reducing stress in the workplace.

Study Design: A systematic review of three randomized controlled trials (RCTs), one containing a 28 day trial extension, published in peer reviewed journals from 2011-2012, all in the English language.

Data Sources: All studies were found using PubMed.

Outcomes measured: All three studies measured stress reduction through biofeedback techniques using subjective patient questionnaires.

Results: All studies showed that biofeedback techniques were effective in reducing workplace stress compared to the control. Manocha et al. made a further distinction between mental silence meditation and relaxation-oriented meditation which includes similar aspects such as relaxation and reflection but would not be considered a true biofeedback technique.

Conclusions: Based on the results of these studies, it seems that there is a benefit of using biofeedback techniques to reduce stress in the workplace. Further research should attempt to; explore the long term benefits across workers in diversified fields, minimize the time and effort it takes to utilize these techniques, and explore the impact technological advances could have on these modalities, all of which would likely increase the usage and effectiveness of these techniques.

Key words: Biofeedback techniques, stress, and workplace

INTRODUCTION

One of the few traits nearly every human being has in common is a concern for their health and well-being. In our quest for optimal health and wellness, we know that it is essential to eat healthy and stay active. Mental health, however, remains a fundamental yet overlooked component of one's well-being. Testimonials of the effects of practices such as meditation, yoga, and mindfulness date back centuries but have just recently started to be confirmed through scientific evidence. Virtually all chronic health conditions contain a link to inflammation, including but not limited to: cardiovascular disease, cancer, diabetes, obesity, and depression.⁹ Meanwhile, studies also show a connection between inflammation and stress. Stress can be defined as “a particular relationship between the person and environment that is appraised by the person as taxing or exceeding his or her resources and endangering his other wellbeing”.³

The percentage of Americans who reported experiencing at least one symptom of stress over the past month rose from 71% in August 2016 to 80% in January 2017.⁷ Furthermore, 36% of people report that reducing stress is a priority over the next several years.⁷ These two profound statistics prove that this is a growing problem in healthcare and that people want a solution. They represent the supply and demand for healthcare providers.

In 2014, 11.45 million people were counseled on stress management in outpatient clinics.⁴ One of the major sources of this stress comes from one's job. According to the American Psychology Association, 61% of Americans report work as a stressor.⁷ It is estimated that health problems stemming from employment-related stress can lead to fatal conditions that kill at least 120,000 Americans each year and account for up to \$190 million in annual health care costs.²

What makes stress so difficult to control is the reality that the factors that cause it, such as work, school, family and illness, are virtually impossible to avoid. Additionally, there isn't any way to directly treat "stress" medically. Oftentimes people don't know how to deal with their stress until it is too late and more serious symptoms have developed. Healthcare providers are then forced to play catch-up by attempting to treat these major chronic health issues. Rather than spending resources on medications and surgeries that try to fix or control the effects these diseases have on the body, a more efficient strategy would be to focus efforts toward avoiding the first step which leads to the disease. This idea is commonly referred to as preventative medicine.

This is the area in which biofeedback techniques can play a pivotal role in the future of healthcare. Biofeedback techniques, like meditation and mindfulness, attempt to train the body to control normally involuntarily processes such as heart rate, blood pressure, and muscle tension.⁸ These techniques often come at low or no cost, are applicable to all people, and can aid in preventing a myriad of illnesses. If these simple, benign techniques are proven to reduce stress and inflammation, they will become essential tools of therapy in preventing chronic illness.

The causal relationship from work to stress to inflammation to illness has been clearly established and biofeedback techniques have been used to lower stress levels for centuries. What is not yet known is if these techniques can gain prevalence and adherence amongst the masses. As mentioned earlier, many know that diet and exercise are instrumental to staying healthy yet not enough people actually implement these practices. Whether biofeedback techniques will be used as a viable treatment option in the future is to be determined but in this systematic review the author aims to evaluate their ability to reduce workplace stress specifically and discover if the results are substantial enough to warrant widespread utility.

OBJECTIVE

“The objective of this selective EBM review is to determine whether or not biofeedback techniques are effective in reducing stress in the workplace.”

METHODS

Three randomized controlled trials, one including a 28-day open-label trial extension, that included any employee with stress, were selected for this study. A 12 week study by Wolever et al. used an intervention of 14 total hours of a Mindfulness at Work program. This intervention was compared to 12 hours of a Viniyoga Stress program and a control group who received a list of health resources available to all employees of the company. Mindfulness has been described as the “nonjudgmental observation of the ongoing stream of internal and external stimuli as they arise”, or as “the practice of paying attention in a particular way, on purpose, in the present moment and nonjudgmentally”.⁹ Viniyoga differentiates itself from other yoga traditions by focusing on primacy of the breath, the importance of asana sequencing (physical postures of yoga), and adaptation of the practice to the practitioners and/or their goal(s).⁹

Another RCT, Lemaire et al., used a brochure on health and wellness, a 30 minute presentation, and a combination of rhythmic breathing, self-generated positive emotion, and a biofeedback device for 5 minutes 3 times per day for 28 days compared to just the brochure on health and wellness. Both groups also had a research assistant contact each participant twice weekly to measure stress and well-being, heart rate and blood pressure. This study also included a trial extension of an additional 28 days. The intervention group was free to continue or discontinue the use of the biofeedback techniques as they wished. The control group was given the same equipment and instruction that the intervention group had during the RCT portion but neither group was followed up on by research assistants biweekly during the extension.

The last study by Manocha et al. was an eight week trial consisting of two 1-hour sessions per week of mental silence meditation compared to two 1-hour sessions per week of relaxation-oriented meditation and a control group. Mental silence meditation (MSM) focuses on the absolute present state and can be described as “thoughtless awareness.”³ Relaxation-oriented meditation was designed specifically for this study and comprised of resting in a quiet place and reflecting on the day’s events³. This technique was included to better distinguish what elements of meditation make it effective. The relaxation-oriented technique allows subjects to relax and thoughtfully process information but they were not equipped with specific techniques intended to alter the body’s physiology.

“Biofeedback” AND “stress” AND “workplace” were keywords used in the PubMed searches. The articles were published in English. The inclusion criteria were RCTs published from 2006-2016 with patient oriented evidence that matters (POEMs). The exclusion criteria were if subjects were not employed or the evidence was strictly disease-oriented (DOE). Statistics used included P-value, confidence interval, numbers needed to treat (NNT), and mean/median change from baseline.

In Wolever et al., 239 employees of a national insurance carrier with a baseline score of 16 or higher on the Perceived Stress Scale (PSS) were recruited via email. In Lemaire et al., 40 physicians in Canadian urban tertiary centers were recruited using e-mail, mail, and flyers around the hospital. In Manocha et al., 180 subjects in the central business district of Sydney, Australia were recruited through newspapers and other media outlets. Elaboration on the demographics of subjects in these studies, including the specific inclusion and exclusion criteria, can be found in Table 1.

Table 1 - Demographics & Characteristics of included studies

Study	Type	#Pts	Age	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Lemaire (2011)	RCT w/ trial extension	40	Mean age = 46.3	Staff physicians practicing in an urban tertiary care center.	Potential participants who screened positive for major depression with the 9-item Patient Health Questionnaire (PHQ-9) depression scale	0	A brochure on health and wellness, a 30 minute presentation on how to use a combination of rhythmic breathing, self-generated positive emotion, and a biofeedback device
Wolever (2012)	RCT	239	Mean age = 42.9	A score of 16 or higher on the 10-item Perceived Stress Scale	An arrhythmia requiring medication or a pacemaker; pregnancy; heavy tobacco or nicotine use; medications that would affect HR; any major medical condition or psychological disorder; yoga or meditation experience	34	14 total hours of a Mindfulness at Work program taught in person over a 12 week period.
Manocha (2011)	RCT	180	Mean age = 42.1	Full-time employment; willing to commit to the instructional program and twice daily practice at home; willing to fill out a questionnaire battery before and after study	Smoking; >2 units of alcohol daily; Recreational drug use; Serious psych/medical morbidity; Use of other stress management strategies in the past 12 wks; Recent stressful major life event	57	Two 1-hour sessions of mental silence meditation per week for 8 weeks.

OUTCOMES MEASURED

The primary outcome, stress reduction, was measured by The Perceived Stress Scale (PSS), 15 items from The Perceived Stress Scale plus 25 items selected from the Personal and Organizational Quality Assessment-Revised (POQA-R) questionnaire to combine for a 40 question assessment, and the Psychological Strain Questionnaire (PSQ). The PSS measures the degree to which situations in one's life are appraised as stressful and how people think they deal with stress⁵. It is the most widely used psychological instrument for measuring the perception of stress.⁵ The Personal and Organizational Quality Assessment questionnaire includes Personal Quality scales that directly reflect employees' day-to-day moods, attitudes and stress-related symptoms and Organizational Quality scales that examine key areas that influence employee job involvement, performance and important factors related to employee behavior, attitudes toward work, and ability to perform well.⁶ The Psychological Strain Questionnaire is an accepted measure that focuses on work stress specifically.³

RESULTS

In the RCT with Mindfulness, Viniyoga, and control groups, Wolever et al. found that both Mindfulness (p-value < .001) and Viniyoga (p-value < .01) significantly reduced stress levels when compared to the control group (Table 2). No significant differences emerged in the reduction of stress between the Mindfulness at Work program and the Viniyoga stress program. Of the 239 participants, 205 completed the study with no significant differences of attriters between groups. It is unclear why participants dropped out but the article mentions that the attriters did not differ from those who completed the study in any socio-demographic or baseline variables. Compliance between both intervention groups was the same at 81%.

Table 2

	PSS before	PSS after	p-value compared to control
Mindfulness	24.72	15.86	<.001
Viniyoga	24.93	16.74	<.01

In another RCT carried out by Manocha et al., participants were randomly divided into groups of mental silence meditation (MSM), relaxation-oriented meditation, and a control group that was told they were on the “wait list” for the study. When comparing the MSM group to the control group, there was a significant improvement in stress reduction through the intervention (p-value = .034, CI: 1.22–5.68). When comparing relaxation-oriented meditation to the control group there was not a significant improvement in stress scores (p-value = .546, 95 CI: 0.589–2.724). As shown in Table 3, when you compare the median change from baseline, there is a significant improvement in the MSM group when compared to both the relaxation-oriented and control groups (p-value = .026). It is important to note there was a high dropout rate for this study (57/180). However, there was not a significant difference between groups or between dropouts and those who finished the study.

Table 3

	MSM group	Relaxation-oriented group	Control group	<i>p-value</i>
Median change from baseline	37	22.3	17.5	.026

In the last study performed by Lemaire et al., a 28 day RCT was performed along with a 28 day trial extension where the control group was able to try the intervention. During the original RCT portion, the intervention’s mean change from baseline stress score was -14.7 (p-value = .013) and the control group’s was -2.2 (p-value = .30) meaning there was a statistically significant reduction in stress within the intervention group but not the control group. There was also significant reduction in stress when directly comparing the intervention group to the control

group (p-value = .048). Furthermore, 15/20 (75%) physicians in the intervention group and 10/17 (59%) physicians in the control group reported decreases in stress from Day 0 to Day 28. These values were used to calculate a numbers needed to treat (NNT) of 7. This means that for every 7 physicians who receive the intervention, one more will have stress reduction when compared to those in the control group (Table 4). After the trial extension, 14/21 (67%) physicians in the original intervention group reported a decrease in stress symptoms from Day 0 to Day 56 (p-value = .12) resulting in a significant mean change in stress of -13.0 (p-value = .027). In the control group, now applying the intervention, 15/18 physicians reported a decrease in stress symptoms (p-value = .005) from Day 28 to Day 56 resulting in a mean change in stress of -8.5 (p-value = .001). The 95% confidence interval for the intervention from Day 0 to Day 28 (-25.8 to -3.6) was not significantly different (p-value = .30) from the 95% confidence interval from Day 28 to Day 56 when the control group was exposed to the intervention (-12.3 to -4.7).

Table 4

		Relative benefit increase (RBI)	Absolute benefit increase (ABI)	NNT
Control (CER)	Intervention (EER)	$\frac{\text{EER}-\text{CER}}{\text{CER}}$	EER-CER	1/ABI
0.59	0.75	0.27	0.16	7

DISCUSSION

In Wolever et al. reductions in stress were seen in both the Mindfulness and Viniyoga groups when compared to the control group but no significant differences were observed between these interventions. These results help enforce the idea that there may not be one preferred biofeedback technique but one can find a legitimate technique that works for them and implement such to reduce their workplace stress. This study also explored the effect of these interventions on work productivity. Subjective improvement in this area was not found to be

significant but if additional research could prove an increase in work productivity it would encourage employers to support such interventions more regularly. If there was time allocated to performing these interventions within the workplace it may increase utility and compliance. In this study there was also a group that used the Mindfulness at Work program through web-based instruction. The results were not focused upon for this systematic review in hopes to remain concise but this group was also successful in significantly reducing stress. Further research in this area should be explored to help combat barriers to use. In studies such as these, where the focus groups are already admitting they are stressed, accessibility could be a major problem when it comes to widespread utility and adherence to such interventions.

In Manocha et al. significant stress reduction was noted within the mental silence meditation group but not the relaxation-oriented meditation or control groups. To clarify again, relaxation oriented meditation was created for this study and included reflecting on the events of the day in a quiet, dark place³. The results of this study prove that novel use of meditation may not be effective in reducing stress and affirm that anybody looking for substantial benefit should search for legitimate, evidence-backed techniques to use. One drawback of this study was that 57/180 (32%) participants dropped out. It is theorized that forcing participants to attend a separate site after normal work hours led to this high dropout rate³. As mentioned above, allocating time during normal work hours or allowing these programs to be more readily accessible would likely improve dropout rates.

Lemaire et al. proved that a combination of rhythmic breathing, active self-generated positive emotion, and a portable biofeedback device to reinforce positive physiological change is effective in reducing workplace stress among physicians. Not only was it effective for the intervention group during the RCT portion but also for the control group exposed to it during the

trial extension. One benefit of this study was that the methods were used 3 times for 5 minutes each day, a total of just 15 minutes daily. Another interesting portion of this study is that “nearly all” subjects reported that they would continue using the intervention techniques because of their positive effects¹ but the exact numbers were not published as data. One restraint noted in this study was that stress is a multi-layered phenomenon and the study did not evaluate which kinds of stress were decreased and which were not¹. Also, the measuring scale for this study was created by the researchers, composited from multiple other accepted measures but was not able to be widely accepted as a legitimate means of measurement itself.

A restraint shared amongst all 3 of these studies is a lack of variability in workplace. Two studies were focused only on corporate workers and the other only on physicians. Another restraint was that the studies were only 12, 8, and 8 weeks long, respectively. Also, follow-up in these studies was either absent or not explained thoroughly. Future studies should attempt to diversify workplace settings and observe the long term impact of biofeedback techniques on workplace stress. Lastly, because the subjects were actively participating in the interventions these studies could not be double-blinded.

CONCLUSION

The hypothesis of this systematic review was ultimately proven correct. A variety of biofeedback techniques are effective in reducing workplace stress. Further research should branch away from just corporate employees and physicians and test the effects of these techniques on as many workers in as many different settings as possible. Biofeedback techniques can only have a bright and significant future in healthcare if they are available to everyone. Therefore, barriers to use should be minimized. With the emergence of holistic and preventative medicine, many patients and providers are already looking for this kind of non-pharmacologic

treatment tool but any such intervention would have to compete against the convenience of swallowing a pill or having a surgery. Nonetheless, one study showed that with just 15 minutes a day their techniques can effectively reduce stress.¹ Further studies should attempt to establish a minimum usage threshold while carefully maintaining effectiveness. It would also be worthwhile to explore the effect that technology can have both on bringing awareness to these options, as well as increasing their effectiveness. Given that these techniques are low to no cost and offer zero side effects, it is crucial that efficacy be proven across all demographics and that time of use be reduced to just a few minutes a day. If future research can show improvement in these areas, then biofeedback techniques stand a real chance of becoming a perfectly viable treatment option in the immediate future.

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